We claim

1. A crystallizer for casting low melting point metals and their alloy, comprising a base (1), end mould (2), mould seat (6, 7) on the end mould (2), film mould (8, 9), characterized in that a plurality of straightedges (16) arranged on the inner side of said mould seats in the radiation shape, the shape of the inner side of these straightedges corresponds with that of the outer periphery of the mould walls(8-1, 9-1) of film moulds (8, 9), the inner periphery of mould walls (8-1, 9-1) corresponds with the outer periphery of the casting, between the adjacent straightedges is a vertical gap which forms a slot (17-1), the film moulds (8, 9) are fixed on the mould seats by the locating part so that the slot (17-1) is closed to become the cycle passage of the cooling medium, i.e. medium channel (17); on the upper end of the medium channel (17) there is a water-supplying port (5) and the lower end of the medium channel (17) is communicated with the water drain pipe (12).
2. The crystallizer according to claim 1, characterized in that a plurality of straightedges (16) are fixed on the inner side of the mould seats (6, 7) or formed on the inner side of the mould seats(6, 7) as an integrated body.
3. The crystallizer according to claim 1, characterized in that a plurality of straightedges (16) are arranged on the inner side of the mould seats (6, 7) vertically.
4. The crystallizer according to claim 1, characterized in that the inner side of a plurality of straightedges (16) is cut by an cutter to form a fringe (21), the outer periphery of the cutter corresponds with that of the mould wall (8-1, 9-1) of the film mould.
5. The crystallizer according to claim 1, characterized in that the sectional shape of the fringe on the inner side of the straightedge (16) is triangle which is truncated by the cutter.
6. The crystallizer according to claim 5, characterized in that the length of truncate arc of said straightedge is 0.5 ~ 6mm, the arc of the two adjacent fringes truncated by cutter is 2 ~ 50mm long.
7. The crystallizer according to any of the preceding claims, characterized in that said cutter is

cylinder (22), whose surface corresponds with the outer periphery of the mould wall (8-1, 9-1) of the film mould.

8. The crystallizer according to any of the preceding claims, characterized in that said mould seat (6, 7) has at least two mould closing fits (53, 55, 57, 59) along the mould joint, said film mould (8, 9) consists of the mould wall (8-1, 9-1) and a mould ear (8-2, 8-3, 9-2, 9-3), the mould wall (8-1, 9-1) extends a width along the mould joint to form the mould ear (8-2, 8-3, 9-2, 9-3), which is tightly pressed between the mould closing fits of the mould seat.

9. The crystallizer according to claim 8, characterized in that the film mould has a locating part which consists of a plurality of inserting slots (23) disposed on the mould closing fits and pins (8-4, 9-4) disposed on the mould ear.

10. The crystallizer according to claim 1, characterized in that the ratio of the thickness of the film mould to the diameter of the cylindrical casting is between 0.0015~0.006.

11. The crystallizer according to claim 1, characterized in that the film mould is made of the martensite heat resistant steel.

12. The crystallizer according to claim 8, characterized in that on the end mould (2) is arranged an upper part (26) which corresponds with the inner periphery of mould wall (8-1, 9-1), the end mould (2) is fixed on the mould base (1), the mould seats (6, 7) slides on the end mould (2); the cylinder (22) cuts the inner side of mould seats (6, 7) to form a the ring (25), the bottom of the film mould (8, 9) is clamped between the upper part (26) and the ring (25).

13. The crystallizer according to claim 1, characterized in that the water drain pipe (12) is communicated to a water-discharging port (11) through a soft pipe (14); the water-discharging port (11) is fixed in a liquid level controller (10), and the liquid level controller (10) stops at the determined height or ascends and descends at the determined speed.

14. The crystallizer according to any of the preceding claims, characterized in that at the top of said crystallizer are arranged a top core (71), and an operating mechanism (74) for placing and de-moulding the top core (71).

15. The crystallizer according to claim 14, characterized in that at the top of said crystallizer is arranged a heater (73) for heating the top core.

16. The crystallizer according to claim 14, characterized in that said top core is made of silicon nitride material.

17. The crystallizer according to claim 1, characterized in that it further comprises metal moulds (52, 62), which are imbedded in the space formed after cutting away a part (49, 50) of the mould seats (6, 7) along the mould joint, the metal moulds (52, 62) have at least two mould closing fits (54, 56, 58, 60) arranged along the mould joint, the shape of the inner side of metal moulds (52, 62) and the inner periphery of mould walls (8-1, 9-1) are combined to form the peripheral shape of the tubular casting.

18. A method for casting using said crystallizer according to any of the preceding claims, comprising the following steps:

(a) the melting stock (30) is poured into the mould cavity of said crystallizer at the determined velocity, said determined velocity must enable the melting stock liquid levels (35, 38 and 76) in the mould cavity to be higher than the cooling medium liquid level (34) in the medium channel;

(b) when the melting stock (35, 38 and 76) fills up the bottom part of the mould cavity, and submerges the bottom end of a pouring pipe (28-1) up to 10 ~ 30 mm in depth, open the water distribution box (72), and pour cooling medium (33) into the medium channel (17) through a plurality of water-supplying ports (5);

(c) the value R of the longitudinal sections of the tubular casting controls the ascending speed of cooling medium liquid level (34), and R is the speed of the vertical movement of the casting crystallization interface;

(d) when the crystallization interface approaches the top of the tubular casting, the final liquid depression of casting is made a neck-in treatment; said neck-in treatment is to reduce the ascending speed of cooling medium liquid level (34), or to put it at zero;

(e) when the neck-in treatment is over and casting is through with crystallization, stop

supplying water, and drop water-discharging port (11) below the bottom end of the medium channel with the liquid level controller (10), and exhaust the cooling medium in the medium channel; and

(f) after the cooling medium is exhausted in the medium channel, all the parts of the crystallizer is kept in an intermediumte state and enter an air-cooling time period of 10 to 90 seconds, then de-moulding is performed, the casting is taken out, and enters the next casting cycle.

19.The method according to claim 18, characterized in that the following formula is used to calculate vertical movement speed R of the crystallization interface of longitude sections of the tubular casting:

$R=COS\alpha \quad (\lambda sGTS\text{-}\lambda LGTL)/\sigma S\Delta h$ (Formula II)

wherein:

λ s- solid phase thermometric conductivity;

λ_L – liquid phase thermometric conductivity;

G_{TS} – temperature gradient of the horizontal unit length of the solid phase;

G_{TL}– temperature gradient of the horizontal unit length of the liquid phase;

σ S – solid phase density;

Δ h – Latent heat of solidification;

α - included angle between crystallization interface and horizontal level

value R of the crystallization interface of the longitude sections of the tubular casting is used as the determined value of the speed of the cooling medium liquid level (34).

20. The method according to claim 18, characterized in that when there is the top core (71) on the top of the crystallizer mould cavity, the method further comprises the following steps:

(g) the heater (73) heats the top core (71) to keep its temperature above the temperature of the liquid phase point of the cast metal; and

(h) operating mechanism (74) is used to put the top core (71) into the mould cavity before

pouring, and after crystallization of the casting, the operating mechanism (74) is used to de-mould the top core (71), which is put into the heater (73) to keep its temperature.

21. The method according to any of claims 18-20, characterized in that if the pouring cup (28) with pouring pipes (28-1) is used to pour the melting stock into the mould cavity, the method further comprises the following steps:

(i) stretch the pouring pipe (28-1) of the pouring cup (28) to the bottom part of the mould cavity before pouring; and

(j) after pouring begins, when the melting stock liquid level (35, 38, 76) in the mould cavity of the crystallizer of step (b) submerges the bottom end of the pouring pipe (28-1) up to 10 ~ 30 mm in depth, the pouring cup (28) and the pouring ladle (31) are lifted synchronously, at a speed kept the same as the ascending speed of melting stock liquid level (34), before all the melting stock of one casting cycle is used up, the bottom end of the pouring pipe (8) remains 10-30 mm below the melting stock liquid levels (35, 38, 76).

22. The method according to claim 21, characterized in that the radial section shape of the pouring ladle (31) is designed into a sector whose circle center is invert center (29), the inverse unit angle of the pouring ladle corresponds to the given weight of the melting stock poured out, and the speed at which melting stock liquid levels (35, 38 and 76) ascend is adjusted by controlling the angle speed of the inverse of the pouring ladle.